ABSTRACT

Reconstruction studies of seasonal rainfall utilizing stable isotope based proxy approach suffer from the limitations of time resolutions. Conventional methods and archives limit the achievable resolution to annual scales. However, high resolution reconstruction (seasonal to sub-weekly scale) can be achieved in proxy records where growth rates are high enough to leave spatial signatures in an organically or inorganically deposited layer such as growth bands. In this study, aragonitic skeleton of the gastropod *Lissachatina fulica* (Bowdich, Giant African Land Snails) is investigated with an aim to achieve sub-weekly scale reconstruction of the Indian monsoon rainfall. These terrestrial gastropods are native of Africa and highly invasive. Their evolution in the geological time period dates back to the Pliocene and is presently distributed across the tropical belt. They exhibit a high growth rate in the presence of water and high relative humidity in the environment. As a result, they are ideally suited for the task of palaeo seasonality reconstruction. The isotopic patterns recorded in their growth bands reveal composition of environmental water at seasonal time scales. *In vitro* studies were carried out on *L. fulica* to estimate their growth rates and growth responses to changes in the physical conditions within the culture chamber.

The Indian monsoon rainfall exhibits characteristic dry spells that are generally sandwiched between periods of active phases of high rainfall during the South West monsoon season. These dry spells are typically characterized by rainfall with low intensity. Isotope fingerprinting of the rain water at daily time resolution, covering the years of 2007-10 exhibited distinct isotopic ratios for the dry and wet spells. Dry spells were clearly demarcated in the

record with isotopically enriched signature. In addition, the study indentified the role of three distinct moisture sources on $\delta^{18}O$ of rain water at Bangalore, India. The variability in the oxygen isotopic composition of the Indian monsoon rainfall is predominantly controlled by this source moisture variability at inter annual time scales, while temperature and amount of rainfall tend to dominate the variability in the precipitation isotopes at seasonal and weekly scales.

Simultaneous isotopic analyses of both rainwater and shell carbonates growth bands were undertaken to understand their relationship to aid in high resolution reconstruction. Carbonate found in the growth bands of the gastropods, which is precipitated under equilibrium condition from rainwater, preserves the signature of rainfall. This provides an opportunity to reconstruct rainfall parameters (i.e. amount and moisture sources) knowing the variability in shell carbonates. Stable isotopic ratios measured across the growth bands of live shell specimens collected from the southern and eastern Indian regions (Bangalore and Kolkata, respectively) were compared with the rainfall isotope ratios at these two locations; signature of dry spells were clearly identified from the study of isotopic composition in the growth bands of the gastropod specimens.

The approach was also extended to older samples from historical archives from eastern Indian region (Kolkata, East India). Individual specimens belonging to the same species of gastropod, which were collected during the monsoon season of the year 1918 were used for reconstructing the seasonal pattern in monsoon rainfall over the region. The record of variation in the isotopic composition seen in the shell was compared with the rainfall data from Indian Metrological Division observatory at Kolkata station. The year 1918 was characterized as a

major drought year and the signature of dry period was seen preserved in the specimen. The work under taken in this thesis will widen the scope of seasonality reconstruction using terrestrial shell fossils from palaeo records, which have been rarely investigated in paleoclimate studies from the perspective of understanding the seasonal precipitation variability.